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Organisation de Coopération et de Développement Economiques
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CURRENT SEVERE ACCIDENT RESEARCH FACILITIES AND PROJECTS

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996); Korea (12th December 1996) and the Slovak Republic (14th December 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1st February 1958 under the name of the OEEC European Nuclear Energy Agency. It received its present designation on 20th April 1972, when Japan became its first non-European full member. NEA membership today consists of 28 OECD member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Republic of Korea, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the Agency.

The mission of the NEA is:

- to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
- to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information. The NEA Data Bank provides nuclear data and computer program services for participating countries.

In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

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WORKING GROUP ON THE ANALYSIS AND MANAGEMENT OF ACCIDENTS

The Working Group on the Analysis and Management of Accidents (GAMA) is mainly composed of technical specialists in the areas of coolant system thermal-hydraulics, in-vessel protection, containment protection, and fission product retention. Its general functions include the exchange of information on national and international activities in these areas, the exchange of detailed technical information, and the discussion of progress achieved in respect of specific technical issues. Severe accident management is one of the important tasks of the group.

FOREWORD

The “Current Severe Accident Research Facilities and Projects” list had initially been compiled by J. Royen, Secretary of the Working Group on the Analysis and Management of Accidents (GAMA).

It was updated by W. Scholtyssek (FZK) with the assistance of the members of GAMA.

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CURRENT SEVERE ACCIDENT RESEARCH FACILITIES AND PROJECTS

REVISED OCTOBER 2003

In-Vessel Phenomena:Core Degradation and Melt Progression:

CANDU Core Disassembly Test Facility	AECL (CAN)	Scale model of CANDU channels under total loss of heat sinks.	'christine.gueneau@cea.fr'
ISABEL	CEA (FRA)	UOZrFe thermodynamic database validation.	
MADRAGUE	IRSN (FRA)	Single rod (60 cm length) and crucibles to study the degradation of B ₄ C absorber rods as well as non-irradiated and irradiated fuel rods (UO ₂ and MOX), under representative T/H conditions (Programme in progress).	'annie.constant@irsn.fr'
PHEBUS-FP	IRSN (FRA)/JRC (EC)	Core melt progression from irradiated fuel rod bundles including control rod and structural materials: 3 tests performed over 4 planned. Accident progression from irradiated core debris to molten pool: 1 test performed.	'michel.schwarz@irsn.fr' 'bernard.clement@irsn.fr'
DEBRIS	USTUTT-IKE (GER)	Experiments on coolability of inductively heated particulate debris, aiming at constitutive laws for conditions of boil-off of water filled beds as well as quenching of initially dry hot debris under top and bottom flooding; influence of system pressure included.	'groll@ike.uni-stuttgart.de'

KESS	USTUTT-IKE (GER)	Model and code development on core melting, core degradation (melt accumulation in core and outflow modes) ⇒ modules for ATHLET-CD.	-buerger@ike.uni-stuttgart.de
LIVE	FZK (GER)	Investigation on phenomena during the phase of transient core melt relocation to the lower plenum, formation of molten pools (project started 2002, facility under construction). Component of EU LACOMERA platform.	'tromm@iket.fzk.de
QUENCH	FZK (GER)	Reflood of overheated core, early phase of core melt progression. <i>Component of EU LACOMERA platform.</i>	'miassoedov@imf.fzk.de 'steinbrueck@imf.fzk.de
CODEX	KFKI (HUN)	VVER and PWR core degradation: air ingress transient in PWR core, B4C effects, quench effects.	'hozer@sunserv.kfki.hu
MIR Water Loop	RIAR (RUS)	VVER fuel bundle degradation tests (SB LOCA).	
CIT	EC Project 4 FWP	Separate effects tests to assess thermochemical properties and materials interactions governing molten corium formation and progression. Completed. Information available through reports.	'bernard.adroguer@irsn.fr
COBE	EC Project 4 FWP	Single rod and bundle quenching tests under representative T-H conditions and different flooding approaches; analysis of quench, debris bed and molten pool phenomena. Completed 1999, final report EU 18982 EN.	

COLOSS	EC Project 5 FWP	Consequences of core degradation (B4C oxidation, U-O-Zr oxidation, fuel rod dissolution) on H2 production, melt generation and source term. Improvement and validation of Severe Accident computer codes. Completed in 2003.	'bernard.adroguer@irsn.fr'
OPSA	EC Project 4 FWP	Single rod and bundle air ingress tests. Completed 1999, final report EU 19528 EN.	
SARA	EC Project 4 FWP	To determine magnitudes and gradients of possible recriticality transients, assess the impact of recriticality on accident progression (completed).	

Molten Core Debris Interaction with the Reactor Pressure Vessel Lower Head and Mechanical Behaviour of Reactor Pressure Vessel Lower Head:

COPO II	FORTUM (FIN)	Heat transfer from molten pool in the reactor pressure vessel lower head.	
BALI	CEA (FRA)	Heat transfer coefficients between molten pool and walls. (Program completed and installation closed)	
SILFIDE	EDF (FRA)	Particulate debris bed coolability. Completed. Facility currently in standby position	
SULTAN	CEA (FRA)	In-vessel retention by external cooling. (Program completed and installation closed)	

CORCOM	Tech. Uni. München (GER)	Coolability of a porous debris bed with or without a gap between the bed and the RPV wall; cooling phenomena in a gap between a solidified impermeable debris block and the RPV wall.	
DEBRIS	USTUTT-IKE (GER)	Experiments on coolability of inductively heated particulate debris, aiming at constitutive laws for conditions of boil-off of water filled beds as well as quenching of initially dry hot debris under top and bottom flooding; influence of system pressure included.	groll@ike.uni-stuttgart.de
“Debris-RPV Wall Interactions” Research Project	GRS/Tech. Uni. München/ Uni. Stuttgart/ F-ANP (GER)	Thermal-hydraulic phenomena occurring in a gap between the debris crust and RPV wall.	
KESS	USTUTT-IKE (GER)	Relocation to lower plenum, breakup and particulate debris formation (coolability), remelting and RPV attack ⇒ modules for ATHLET-CD.	buerger@ike.uni-stuttgart.de
LIVE	FZK (GER)	Investigation on phenomena of stability of molten pools and interaction with vessel wall. (project started 2002, facility under construction) Component of EU LACOMERA platform	tromm@iket.fzk.de
ALPHA	JAERI (JPN)	In-vessel debris coolability. (Dismantled; issue closed)	

COTELS-LHI	NUPEC(JPN)/ NNC(Kazakhstan)	In-vessel debris coolability by RPV internal water. (completed at end of March 2003, data publicly available through publications and in reports)	'maruyama@nupec.or.jp'
SONATA-IV	KAERI (ROK)	In-vessel retention with internal gap cooling.	
RASPLAV	RRC KI (RUS)/OECD	Heat load to RV lower head in presence of molten pool, interactions using prototypic and simulant materials. (completed)	
MASCA	RRC KI (RUS)/OECD	Investigation of prototypic in-vessel corium properties (effect of composition on stratification and vessel load; FP partitioning) at high temperatures. To be completed by mid-2003. Follow on programme under discussion.	
STF	RRC KI (RUS)	In-vessel debris coolability.	
BIVCOT	KTH (SWE)	<u>BWR</u> In-Vessel Coolability with Control rod and guide Tubes. These are two facilities, one a modification of the POMEKO facility and another that of COMECO in which the potential for cooling the BWR melt inside the lower plenum through water introduced in the control rod guide tubes is investigated.	'sehgal@ne.kth.se'

FOREVER	KTH (SWE)	1/10th scale prototypic vessels containing binary oxide simulant melt, maintained at 1,200 °C and pressurized up to 40 bars to measure creep, determine failure modes and determine efficacy of gap cooling. Several experiments have been performed under the MSWI and ARVI Partners. The facility is active.	sehgal@ne.kth.se
SIMECO	KTH (SWE)	Investigation of heat transfer from melt pool convection to pressure vessel walls and to vessel interior. The facility is a 1/8 th scale slice vessel in which fluids upto 300°C can be employed. Isothermal conditions are maintained at pool boundaries. Stratified pool experiments have been performed. The facility is active.	sehgal@ne.kth.se
ACOPÖ	UCSB (USA)	Heat transfer from molten pools.	
EPRI/FAI	FAI (USA)	In-vessel debris coolability.	
SNL-LHF	SNL (USA)/OECD	Mechanical behaviour and failure modes of reactor pressure vessel lower head under high temperature pressurized conditions. (completed in 2001)	
ULPU-2000	UCSB (USA)/Penn State (USA)	External cooling of lower head of RPV. (completed)	
ARVI	EC Project 5 FWP	Investigations include in-vessel melt retention, timing of vessel failure, failure and discharge mode, gap cooling.	sehgal@ne.kth.se

FARO	JRC (EC)	In-vessel debris coolability using 200 kg scale of prototypic reactor materials; Closed at the end of 1999.	
IVCRS	EC Project 4 FWP	Analysis of innovative in-vessel core retention strategies for future nuclear power plants.	
LISSAC	EC Project 5 FWP	Investigation of failure strains of RPV materials under SA conditions. Scaling considerations.	
MVI	EC Project 4 FWP	To validate predictive models for the coupled thermal-mechanics of a convective corium pool and the boundary crust.	sehgal@ne.kth.se
REVISA	EC Project 4FWP	To characterise vessel steels and develop mechanical strength models in order to predict high temperature creep failure under severely damaged conditions.	
RPVSA	EC Project 4 FWP	To investigate the response of vulnerable parts of the RPV by means of creep experiments as well as the melt-through failure of the lower head.	

In-Vessel and Ex-Vessel Molten Fuel/Coolant Interactions:

Molten Fuel/ Moderator Interaction	AECL (CAN)	Integral tests simulating melt ejection from fuel channel into moderator (under construction).	
ANAIS	CEA (FRA)	In-vessel corium pool reflooding, corium/water interaction in stratified situation	' karine.froment@cea.fr '
BILLEAU	CEA/IRSN (FRA)	Premixing (completed).	' karine.froment@cea.fr ' ' edouard.scott-de-martinville@irsn.fr '
KROTOS	CEA (FRA) Formerly JRC (EC)	FCI experiments with prototypic reactor materials; closed at JRC at the end of 1999. (transferred to Cadarache; to be restarted in 2004)	' daniel.magallon@cea.fr '
MICRONIS	CEA/IRSN (FRA)	Fine fragmentation. To be started in 2003.	' karine.froment@cea.fr ' ' edouard.scott-de-martinville@irsn.fr '
TREPAM	CEA/IRSN (FRA)	Heat transfer between water and fine debris. Program in progress (2001-2004).	' karine.froment@cea.fr ' ' edouard.scott-de-martinville@irsn.fr '
BERDA	FZK (GER)	Impact on RV cover of large slug of corium-driven upper structures. (Completed)	
ECO	FZK (GER)	Energy conversion in steam explosions. In progress .	' cherdron@irs.fzk.de '
PREMIX	FZK (GER)	Jet fragmentation, premixing effects. (Completed. Facility mothballed)	' schuetz@irs.fzk.de '
QUEOS	FZK (GER)	Quenching of hot spheres in water (premixing). (Completed. Facility mothballed)	' meyer@iket.fzk.de '
Investigation on loads by steam explosions	USTUTT-IKE (GER)	BMWi sponsored project on safety relevance of steam explosions, related to SERENA.	' bueger@ike.uni-stuttgart.de '

DROPS experiments, DFG project	USTUTT-IKE (GER)	Fine fragmentation of hot drops of melt in strong water flows: influence of material properties on mechanisms.	' buerger@ike.uni-stuttgart.de '
ALPHA	JAERI (JPN)	Premixing, jet fragmentation, propagation. (Planned to be completed in FY 2005)	
COTELS-FCI	NUPEC(JPN)/ NNC(Kazakhstan)	Ex-vessel FCI experiment with prototypic reactor material. Facility closed, data publicly available through publications and in reports.	' kato-masami@jnes.go.jp '
CONVEX	KAERI (ROK)	MFCI, especially premixing, jet fragmentation, and expansion with prototypic materials.	
TROI	KAERI	Experimental programme with corium to investigate FCI.	
MIRA-20L	KTH (SWE)	Premixing, jet fragmentation, for simulant binary oxide melt jets dropped in water at various subcooling; melt volumes up to 20 litres may be used. The facility is moth balled.	' sehgal@ne.kth.se '
MIRA-3L	KTH (SWE)	Similar to MIRA-20L, except with the capacity of 3 litres of melt; facility equipped with continuous X-ray to obtain transient distributions of melt, water and steam volume fractions during MFCI.	' sehgal@ne.kth.se '

MISTEE	KTH (SWE)	Micro Interaction Steam Explosion Experimental facility investigating the explosion and expansion phase of melt drops and small jets upto 2300K. The interaction zone is observed with high speed visual and X-ray photography. The objective is to understand the process to develop accurate models. The facility is active and is in the MSWI programme.	' sehgal@ne.kth.se '
MSWI	APRI Project (SWE) / Consortium	To obtain knowledge about the phenomena active in 'Ex-Vessel MFCI' in order to evaluate accident management schemes considered in Sweden and in other countries	' sehgal@ne.kth.se '
-----	FAI (USA)	In-vessel cooling as a result of gap between melt and vessel wall The facility is moth balled.	
MAGICO-2000	UCSB (USA)	Premixing of FCIs.	
SIGMA-3000	UCSB (USA)	Microinteractions in FCIs.	
CIT	EC Project 4 FWP	Corium properties, viscosity, In-vessel an ex-vessel material interactions. Completed. Information available through reports.	' bernard.adroguer@irsn.fr '
COLOSS	EC Project 5 FWP	In-Vessel material interactions: B4C oxidation, oxidation of U-O-Zr mixtures, fuel rod dissolution including burn-up effects. Completed in 2003. Information available through reports.	' bernard.adroguer@irsn.fr '

ENTHALPY	EC Project 5 FWP	In-vessel and ex-vessel corium thermodynamic database. Completed in 2003. Information available through reports and electronic files.	' anne.de-bremaecker@irsn.fr '
FARO/MFCI	JRC (EC)	Melt jet quenching in water, integral tests with 200 kg scale of prototypic reactor materials; was closed at the end of 1999 (dismantled).	
SERENA	OECD	Working group aiming to obtain convergence on understanding of FCI processes.	' daniel.magallon@cea.fr '

Ex-Vessel Phenomena:*Molten Core Debris/Concrete Interactions:*

ARTEMIS	CEA (FRA)	Corium-concrete interaction with gas sparging (analytical experiments with simulant material).	'karine.froment@cea.fr'
VULCANO –ICB	CEA (FRA)	Corium-concrete interaction. Tests with metal + oxidic corium planned 2003. Freely accessible to EU + Associated countries through EU-PLINIUS project.	'christophe.journeau@cea.fr'
CORESA	Siempelkamp/BMWi (GER)	Simulant corium (oxidic) – concrete interactions; high temperatures and large masses; long-term ablation behaviour; 2D-ablation.	
COTELS-MCCI	NUPEC(JPN)/ NNC(Kazakhstan)	MCCI experiment with and without water injection using prototypic reactor material (completed at end of March 2003, data publicly available through publications and in reports).	'nagasaka@nupec.or.jp'
MACE	ANL (USA)/Consortium	Melt attack and coolability integral experiments with prototypic melts. Programme completed.	'farmer@aeetes.re.anl.gov'
MCCI	ANL (USA)/OECD	Melt attack and coolability separate-effect experiments with prototypic melts. Program started in 2002.	'farmer@aeetes.re.anl.gov'

Molten Core/Ceramic Interaction

ARTEMIS	CEA (FRA)	Corium-ceramic interaction (analytical experiments with simulant materials).	'karine.froment@cea.fr'
VULCANO - P	CEA (FRA)	Melt behaviour during solidification; melt attack and coolability.	'christophe.journeau@cea.fr'
CIRMAT	LSK (RUS)	Ceramic ablation by molten corium	
CIT	EC Project 4 FWP	Ex-vessel ceramic ablation by molten corium. Completed. Information available through reports.	'bernard.adroguer@irsn.fr'
ECOSTAR	EC Project 5 FWP	Demonstrate technical feasibility of ex vessel core melt mitigation measures.	'werner.scholtyssek@psf.fzk.de'
EUROCORE	EC Project 5 FWP	Analysis of corium recovery concepts.	

Melt Release (including DCH), Melt Spreading and Catching Devices Studies:

COLIMA	CEA (FRA)	Basic tests on melt physical properties and corium/materials interactions.	'christophe.journeau@cea.fr'
CORINE	IRSN/CEA (FRA)	Melt spreading (simulant materials). (Completed in 2001)	'karine.froment@cea.fr' 'jean-claude.latche@irsn.fr'
VULCANO-E	CEA (FRA)	Melt spreading (reactor materials). Freely accessible to EU + Associated countries through EU-PLINIUS project.	'christophe.journeau@cea.fr'

COMET	FZK (GER)	Melt cooling by bottom flooding. Component of the EU LACOMERA platform.	'walter.tromm@iket.fzk.de'
DISCO-C	FZK (GER)	Melt dispersion at RPV failure, cold simulant materials (water, Woods metal). (Programme completed. Facility in stand-by.)	'meyer@iket.fzk.de'
DISCO-H	FZK (GER)	Melt dispersion at RPV failure, hot simulant material (Thermite). Component of the EU LACOMERA platform.	'meyer@iket.fzk.de'
KAJET	FZK (GER)	Melt jet interaction with materials and structures in the cavity.	
KAPOOL	FZK (GER)	Melt interaction in the cavity and melt-through of the cavity. (Completed)	
KATS	FZK (GER)	Melt spreading and coolability. (Completed)	
COMAS	AGIK/BMWi and EC Project/Siempelkamp (GER)	Spreading tests with more than 2 tons of prototypic molten corium materials; closed due to withdrawal of the permission by local licensing authorities; facility dismantled.	
SPREAD-2D	KTH (SWE)	A two-dimensional facility for spreading of binary oxide melts on dry and underwater surfaces; melts up to 1,400 °C can be used. The facility is mothballed.	'sehgal@ne.kth.se'
CCTF	SNL (USA)	Melt dispersion and containment heating.	
SURTSEY	SNL (USA) SNL (USA/FRA/GER)	Melt dispersion and containment heating.	

CSC	EC Project 4 FWP	To investigate efficiency and reliability of various core catcher designs with respect to corium spreading and heat transfer issues. (Completed)	
FARO	JRC (EC)	Melt spreading (reactor materials), Closed at the end of 1999.	
HTCM	EC Project/Siempelkamp 4 FWP	To measure the characteristics of heat transfer and the thermal-chemical interactions between prototypic melts and cold structural elements.	

Melt Coolability:

PERCOLA	CEA(FRA)	Coolability. Programme completed and installation closed.	
VULCANO - P	CEA (FRA)	Corium behaviour during cooldown. Freely accessible to EU + Associated countries through EU-PLINIUS project.	'christophe.journeau@cea.fr'
COMET	FZK (GER)	Water injection under a layer of melt. (Component of EU LACOMERA platform.)	
COMET-WABE (partly within KESS and ECOSTAR Projects)	USTUTT-IKE (GER)	Code development to describe porosity formation by water injection from below into melt (COMET concept) as well as top flooding, also including description for subsequent coolability.	'buerger@ike.uni-stuttgart.de'

DEBRIS	USTUTT-IKE (GER)	Experiments on coolability of inductively heated particulate debris, aiming at constitutive laws for conditions of boil-off of water filled beds as well as quenching of initially dry hot debris under top and bottom flooding; influence of system pressure included.	'groll@ike.uni-stuttgart.de'
COMECO	KTH (SWE)	Corium Melt Coolability (COMECO). This facility employs up to 14 litres of simulant melt and evaluates coolability of the melt pool up to 30 cm deep with a water overlay with and without a downcomer inside the melt. The melt is heated from outside. The efficiency of the downcomer to accomplish melt coolability and quenching is investigated. The facility is active under MSWI and ECOSTAR Programsme.	'sehgal@ne.kth.se'
DECOBI	KTH(SWE)	A 3-D melt coolability facility employing coolant injection from bottom of melt pool and/or debris bed; the emphasis is on determining the mechanisms forming porosity needed for melt quenching.	'sehgal@ne.kth.se'
MSWI	APRI Project (SWE) / Consortium	To obtain knowledge about the phenomena active in 'Melt and Debris Coolability' in order to evaluate accident management schemes considered in Sweden and in other countries.	
POMEKO	KTH (SWE)	A 3-D debris bed coolability facility, employing particles (sand or other), heated by electrical heaters, to measure CHF and quench rates; stratified beds and downcomers in the debris bed have been employed.	'sehgal@ne.kth.se'

MACE	ANL (USA)/Consortium	Melt attack and coolability integral experiments with prototypic melts. Programme completed.	' farmer@aeetes.re.anl.gov '
MCCI	ANL (USA)/OECD	Melt attack and coolability separate-effect experiments with prototypic melts. Programme started in 2002.	' farmer@aeetes.re.anl.gov '
STRATIEX	EC Project 4 FWP	To analyse corium stratification.	
THMO	EC Project 4 FWP	To investigate aerosol generation due to MCCI and evaporation resulting from mechanical agitation due to sparging gases.	

Corium Melt properties:

COLIMA	CEA (FRA)	Basic tests on melt physical properties and corium/materials interactions. Freely accessible to EU + Associated countries through EU-PLINIUS project.	' christophe.journeau@cea.fr '
ISABEL	CEA (FRA)	UOZrFe thermodynamic database validation.	' christine.gueneau@cea.fr '
VITI	CEA(FRA)	Measurement of corium viscosity / surface tension by aerodynamic levitation. Freely accessible to EU + Associated countries through EU-PLINIUS project.	' pascal.pilusso@cea.fr '
MASCA	RRC KI (RUS)/OECD		
ENTHALPY	EC Project 5 FWP	In-vessel and ex-vessel corium thermodynamic database. To be completed in 2003. Information available through reports and electronic files.	' anne.de-bremaecker@irsn.fr '

Hydrogen Transport and Combustion:Mixing and Distribution :

C-Bubble	AECL (CAN)	Large-scale gas mixing facility (separate effects, mixing processes).	
CTF	AECL (CAN)	Connected vessels for hydrogen safety testing?	
Diffusion Flame Facility	AECL (CAN)	Large-scale standing hydrogen/steam torch and 90 m ³ enclosure.	
LSGMF	AECL (CAN)	Gas mixing in large room configuration (~ 1,000 m ³)	
VICTORIA	FORTUM (FIN)	Hydrogen (helium) mixing and transport in an ice condenser containment.	
KALI	CEA (FRA)	Hydrogen and steam mixing in a steel vessel with sprays and recombiners	' pierre.gubernatis@cea.fr '
MISTRA	CEA (FRA)	Hydrogen (helium) and steam mixing and transport in a 100m ³ containment with axisymmetric or off-centered injection, 3 thermally-regulated condensers, sprays, N ₂ inerting, compartments.	' henri.paillere@cea.fr '
TOSQAN	IRSN (FRA)	Wall condensation and aspersion model validation Programme from 2001 to 2004.	' jacques.vendel@irsn.fr '
Large-scale Gas Mixing Test Facility	NUPEC(JPN)	Large-scale hydrogen (helium) mixing and distribution test in a model containment vessel with multicompartiment (1600 m ³) and facility dismantled, data publicly available through publications and in reports.	' ogino@nupec.or.jp '

Deflagration:

CTF	AECL (CAN)	6 m ³ and 11 m ³ 10 MPa connected vessels for H ₂ safety testing.	
Diffusion Flame Facility	AECL (CAN)	Large-scale standing H ₂ /steam torch and 90 m ³ enclosure.	
LSVCTF	AECL (CAN)	Large-scale vented combustion test facility.	
ENACCEF	IRSN (FRA)	Combustion test facility, flame acceleration. Started in 2001.	' bernard.chaumont@irsn.fr '
FZK - 12 Meter Tube	FZK (GER)	Combustion facility, flame acceleration and turbulence.	' breitung@iket.fzk.de '
MUSCET	TU Munich (GER)	Explosion tube : flame/obstacles interactions, turbulent deflagrations.	
PET	FZK GER)	Partially vented explosion tube with internal flow obstacles and variable openings, L/D =4.7/0,1 m.	' breitung@iket.fzk.de '
PUFLAG	TU Munich (GER)	turbulence/flame interactions	
LVIEW	U. Pisa (ITA)	Medium scale deflagration tests with full optical access from two directions.	
Small-scale Combustion Test Facility	NUPEC(JPN)	Small scale deflagration test in a single volume and facility dismantled, data publicly available through publications and in reports.	' ogino@nupec.or.jp '
Large-scale Combustion Test Facility	NUPEC(JPN)	Large scale deflagration test in a model containment vessel with multicompartiment (270m ³) and facility dismantled, data publicly available through publications and in reports.	' ogino@nupec.or.jp '

DRIVER and TORPEDO	RRC KI (RUS)	Large-scale closed/vented explosion tubes 174 mm i.d., 12 m length and 525 mm i.d., 35 m length, to study flame acceleration and turbulent deflagrations.	
RUT	RRC KI (RUS)	Large-scale combustion tests, system of connected compartments 100-1600 m ³ , elevated temperatures, steam. Present programme completed. (Future uncertain)	
HYCOM	EC Project 5 FWP	Large scale experiments (RUT) in the slow to fast turbulent regime, development and validation of models and combustion criteria .	'werner.scholtyssek@psf.fzk.de'
HYMI	EC Project 4 FWP	Modelling of turbulent deflagration and experimental validation.	

Deflagration-to-Detonation Transition :

PHTube	TU Munich (GER)	DDT investigations.	
Various Shock Tubes	RRC KI (RUS)	DDT investigations under different conditions.	
RUT	RRC KI (RUS)	Large-scale combustion test facility, system of connected compartments 100-1600 m ³ , elevated temperatures, steam. Present programme completed. (Future uncertain)	
-----	RAS Institute of Chemical Physics (RUS)	Shock tubes, explosive chambers.	

HTCF (Hot Tube)	BNL(USA)/NUPEC(JPN)	Detonation transmission at elevated temperatures	
FZK - 12 Meter Tube	EC Project 5 FWP	Combustion facility, DDT investigations.	'breitung@iket.fzk.de'
H2-DDT	EC Project/RWTH Aachen (GER) 4 FWP	To obtain simple engineering correlations for DDT criteria.	
VOASM	EC Project 4 FWP	To investigate hydrogen deflagration and detonation, and the DDT mechanism.	

Passive Recombiner Performance:

LSVCTF	AECL (CAN)	Large-scale facility with ease of access and short duty cycle.	
H2PAR	IRSN (FRA)	Testing effects of aerosols of fuel simulant material (completed, facility dismantled).	'denis.letenturier@irsn.fr'
KALI	CEA (FRA)	Recombiner testing in atmospheres representative of containment conditions.	'pierre.gubernatis@cea.fr'
ThAI	Becker Technologies / BMWi (GER)	Iodine mass and phase transfer, aerosol behaviour.	
RECA	CIEMAT (SPA)	Autocatalytic recombiner efficiency in the presence of aerosols.	
PARSOAR	EC Project 5 FWP	Up-to-date synthesis on catalytic recombiners.	
THINCAT	EC Project 5 FWP	Development of alternative concept for hydrogen mitigation, catalytic coating of thermal insulation.	

Mechanical Behaviour of Reactor Pressure Vessel Lower Head:

CRATHER	CEA (FRA)	Tensile testing of materials at very high temperature (800-1600 °C) in vacuum or inert gas	
C-SHELL	CEA (FRA)	Crack propagation and kinetic break area associated with pressure decay	' guy.laffont@cea.fr '
FASTHER	CEA (FRA)	Analytical experiment on a tube of vessel grade steel subjected to axial loading and through-thickness thermal gradient.	
RUPATHER-CRATHER	CEA (FRA)	Analytical experiments on tubes of vessel grade steel subjected to internal pressure and localised heating.	' thomas.laporte@cea.fr '

Containment Structural Integrity:Containment Failure Experiment and Analysis:

MAEVA	EDF (FRA)/IRSN (FRA)	Behaviour of reinforced and prestressed high-performance concrete cylindrical wall.	
Facility to study leak behaviour in concrete	Institut für Massivbau und Baustofftechnologie, University Karlsruhe (GER)	Real thickness concrete specimen, predefined cracks, leak behaviour and leak rates under SA atmospheric conditions (p, T, steam).	' lutz.gerlach@ifmb.uni-karlsruhe.de '
PCCV	NUPEC(JPN)/NRC(USA)	PWR Prestressed Concrete Containment Vessel (1/4 scale of PCCV in Japan, demolished in 2002, data publicly available through publications and in reports).	' s-shibata@nupec.or.jp '
RCCV	NUPEC(JPN)	BWR Reinforced Concrete Containment Vessel (basic elements behavior test in maximal strain region, demolished in 2001, data publicly available through publications and in reports).	' s-shibata@nupec.or.jp '
SCV	NUPEC(JPN)/NRC(USA)	BWR Steel Containment Vessel (1/10:scale model of the improved Mark II type in Japan, demolished in 1999, data publicly available through publications and in reports).	' s-shibata@nupec.or.jp '
ATHERMIP	EC Project 4 FWP	To study the thermo-mechanical response of the primary containment penetrations.	
CESA	EC Project 4 FWP	To investigate the micro- and macro-cracking of the MAEVA concrete wall subjected to pressurization loads, and the subsequent off-containment release rates of steam/aerosol mixtures.	

Material Properties and Structural Behaviour:

-----	CEA (FRA)	Concrete cracking under dynamic loads	'christophe.journeau@cea.fr'
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Containment Thermal-Hydraulics:

COPAIN	CEA (FRA)	Heat transfer/flow characteristics during steam condensation on a wall. (Programme completed.)	
MISTRA	CEA (FRA)	Coupled Effect test facility involving steam and helium, sprays, compartments, N2 inerting.	'henri.paillere@cea.fr'
SISYPHE	IRSN (FRA)	PHEBUS-FP containment part, to check experimental devices and help interpreting the T/H results. Completed. (facility currently in standby position.)	'tristan.montanelli@irsn.fr'
TOSQAN	IRSN (FRA)	Heat transfer/flow characteristics during steam condensation on walls.	'jacques.vendel@irsn.fr'
ThAI	Becker Technologies / BMWi (GER)	Multicompartiment thermal-hydraulics, interactions with sump water.	
HDC	EC Project 4 FWP	To investigate containment thermal-hydraulics. (completed)	

Containment Cooling:

PASCO	FZK (GER)	Long-term passive containment cooling (air in natural convection). (completed)	
SUCO	FZK (GER)	Long-term passive containment cooling (sump cooling processes). (completed)	'xu.cheng@iket.fzk.de'
GIRAFFE-DWC	NUPEC/Toshiba(JP N)	Heat removal of BWR drywel cooler under SA conditions (completed and facility mothballed, data publicly available through publications and in reports)	'fukasawa@nupec.or.jp'
PCCS	JAERI(JPN)	Horizontal heat exchanger verification test for long-term passive containment cooling for next-generation BWR. (To be completed in FY 2003.)	
PANDA	PSI (SWI)	Passive containment cooling.	'joerg.dreier@psi.ch'
DABASCO	EC Project 4 FWP	To examine phenomenological processes and contribute to the development of passive engineered mitigation measures.	
EUCOFA	EC Project 4 FWP	To develop a European position on likely future requirements regarding experimental containment test facilities in the medium and large scale range.	
VOASM/HYMI	EC Projects 4 FWP	To examine phenomenological processes and contribute to the development of PARs.	
VVER Bubbler Condenser	EC/Consortium	Bubbler condenser experimental qualification PHARE/TACIS Project.	

Cable Penetration Integrity:

ALPHA	JAERI (JPN)	Electrical cable penetration at high pressure/temperature. (Dismantled; Issue closed)	
COPIAT-PI	NUPEC/Toshiba (JPN)	Integrity of electrical cable penetrations and equipment hatch flanges at SA/AM conditions. (Completed and facility dismantled, data publicly available through publications and in reports)	'a-watanabe@nupec.or.jp'

Fission Products and Aerosols:***Effects of Specific Elements on Iodine Volatility :***

PHEBUS-FP	IRSN (FRA)/JRC (EC)	Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	'michel.schwarz@irsn.fr' 'bernard.clement@irsn.fr'
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Release of Low-Volatility Fission Products/Late In-Vessel Fission Product Release:

EVA/VERCORS	CEA/IRSN (FRA)	FP, actinides and materials release from re-irradiated fuel samples at high temperatures (up to 3000 K) under partially controlled atmosphere.	'gerard.ducros@cea.fr' 'jean-michel.evrard@irsn.fr'
PHEBUS-FP	IRSN (FRA)/JRC (EC)	FP release in RCS and containment Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	'michel.schwarz@irsn.fr' 'bernard.clement@irsn.fr'
VEGA	JAERI (JPN)	FP release and transport from irradiated fuel at high temperature/pressure.	

MP	EC Project 4 FWP	To investigate FP speciation and kinetics metallic and oxidic melts. Complete. Data available from CEC database (http://odmd.jrc.nl). Work continuing in LPP project as part of the EC 5FWP.	' christopher.benson@aeat.co.uk '
VERDON	CEA (FRA)	FP, actinides and materials release from re-irradiated fuel samples at high temperatures (up to 3000K) under partially controlled atmosphere. New facility under planning at Cadarache to replace VERCORS. Should be in operation in 2006.	' gerard.ducros@cea.fr '

Reactor Materials Release:

EMAIC	IRSN (FRA)	Release kinetics from Ag Cd In control rods at high temperatures. (Completed)	' martin.kissane@irsn.fr '
<i>Harrier</i>	AEAT (UK)	Non active simulant studies of late phase release from molten pools. Used in LPP project as part of the EC 5FWP.	' christopher.benson@aeat.co.uk '
RSP	EC Project 4 FWP	To study release kinetics of FP and core materials from molten pools. Project complete. Data available from CEC database (http://odmd.jrc.nl). Facility mothballed due to lack of funding.	' christopher.benson@aeat.co.uk '

Aerosol and Iodine Behaviour in Reactor Coolant System and Containment:

VICTORIA	FORTUM (FIN)	Ice-condenser containment and aerosol test facility.	
MAEVA	EDF (FRA)/ IRSN(FRA)	Aerosol and vapour leakage across high-performance concrete containment wall.	
PITEAS	IRSN (FRA)	Aerosol behaviour in condensing steam conditions (facility being dismantled).	' tristan.montanelli@irsn.fr '
SISYPHE	IRSN (FRA)	To study the mass transfer of gaseous iodine from the containment atmosphere to the painted surface of the condensers under various condensation rates (Close to completion).	' tristan.montanelli@irsn.fr '
PHEBUS-FP	IRSN(FRA)/JRC(EC)	Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	' michel.schwarz@irsn.fr ' ' bernard.clement@irsn.fr '
TOSQAN	IRSN (FRA)	Aerosol removal by spray system. Programme from 2004 to 2005.	' jacques.vendel@irsn.fr '
TRANSAT	IRSN (FRA)	To study aerosol retention in small pipes (20 mm ID). (Completed, facility currently in standby position.)	' tristan.montanelli@irsn.fr '
TUBA	IRSN (FRA)	To study aerosol retention in large pipes (200 mm ID). (Completed, facility being dismantled.)	' tristan.montanelli@irsn.fr '

COPIAT-AT	NUPEC/Toshiba (JPN)	Aerosol trapping effect at damaged electrical cable penetrations and equipment hatch flanges (completed and facility dismantled, data publicly available through publications and in reports).	'a-watanabe@nupec.or.jp'
AIDA	PSI (SWI)	Aerosol - thermal-hydraulic interactions in passive containment condensers.	'salih.guentay@psi.ch'
ARTIST	PSI (SWI)	Aerosol and iodine behaviour in PWR steam generator secondary side.	'salih.guentay@psi.ch'
CONGA	PSI (SWI)/ EC Project 4 FWP	Aerosol - thermal-hydraulic interactions affecting heat transfer characteristics of SWR-1000 passive decay heat removal condenser.	'salih.guentay@psi.ch'
DRAGON	PSI (SWI)	Multipurpose nuclear aerosol and iodine production .	'salih.guentay@psi.ch'
REVENT	ETH Zurich (SWI)	Aerosol re-entrainment from water sump during depressurization.	
APC	EC Project 4 FWP	To investigate the properties of hygroscopic aerosols and aerosol deposition by diffusio-phoresis under severe accident conditions.	
CHEM	EC Project 4 FWP	To investigate vapour-aerosol reactions, aerosol formation and volatile compound generation Project complete. Data available from CEC database (http://odmd.jrc.nl). Facilities mothballed due to lack of funding.	'christopher.benson@aeat.co.uk'

IC	EC Project 4 FWP	To study the behaviour of aqueous iodine in the containment sump Project complete. Data available from CEC database (http://odmd.jrc.nl). Facilities (IODE, Harwell Co-60 cell) discussed elsewhere.	' shirley.dickinson@aeat.co.uk '
ICHEMM	ÉC Project 5 FWP	Improving knowledge of Iodine chemistry, organic iodine behaviour, trapping on metal surfaces. Project to be completed 31 January 2003. Facilities (CAIMAN, SIRIUS, Harwell Co-60 cell) discussed elsewhere.	' shirley.dickinson@aeat.co.uk '
OIC	EC Project 4 FWP	To study the formation of organic iodine in the containment atmosphere. Project complete. Data available from CEC database (http://odmd.jrc.nl). Facilities (IODE, Harwell Co-60 cell) discussed.	' shirley.dickinson@aeat.co.uk '

Retention, Resuspension and Revaporization in Primary Circuit :

-----	AECL (CDN)	Fission product retention.	
PHEBUS-FP	IRSN (FRA)/JRC (EC)	Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	' michel.schwarz@irsn.fr ' ' bernard.clement@irsn.fr '

WAVE	JAERI (JPN)	Aerosol deposition. (Dismantled; Issue closed)	
WIND	JAERI (JPN)	Aerosol behaviour (deposition, revaporization), piping integrity. (Dismantled; Issue closed)	
Falcon	AEAT (UK)	Fission product release and deposition. Project complete. ISP data available. Remainder commercial, with access restricted to UK regulator and EC partners. Facility dismantled/decommissioned due to lack of funding.	'christopher.benson@aeat.co.uk'
-----	AEAT (UK)	FP release & speciation, mass spectroscopy high burnup fuel. Used on RSP. Project complete. Data available from CEC database (http://odmd.jrc.nl). Facility mothballed due to lack of funding	'christopher.benson@aeat.co.uk'
REVAP	EC Project 4 FWP	To test adequacy of FP models to cover revaporization.	
RVP	EC Project 4 FWP	Separate effects simulant studies on revaporization phenomena in the primary circuit. Project complete. Data available from CEC database (http://odmd.jrc.nl). Facility mothballed due to lack of funding.	'ann.tuson@aeat.co.uk'
STORM	JRC (EC)	Liquid and solid aerosol deposition and resuspension in pipes Closed in 1999.	

Aerosol Nucleation and Transport:

PHEBUS-FP	IRSN(FRA)/JRC(EC)	Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	' michel.schwarz@irsn.fr ' ' bernard.clement@irsn.fr '
TRANSAT	IRSN(FRA)	To study aerosol retention in small pipes (20 mm ID). Completed. Facility currently in standby position.	' tristan.montanelli@irsn.fr '
TUBA	IRSN (FRA)	To study aerosol retention in large pipes (200 mm ID). Completed . Facility being dismantled.	' tristan.montanelli@irsn.fr '
PHEBEN	EC Project 4 FWP	Uses PHEBUS-FP data to validate codes and models for aerosol and vapour transport and deposition in the primary circuit and containment.	

Source Term:

ASTERISM	EC Project 4 FWP	To design an appropriate (pilot) archive for source term data and models.	
ASTERISM II	EC Project 5 FWP	Extension of a prototype data base containing source term relevant data.	
CONT-LEAK	EC Project 4 FWP	To assess direct applicability to full-size plants of experimental ST results and ST code calculations.	
LPP	EC Project 5 FWP	Quantification of fission product and core materials released from molten corium and leaching from solidified corium. Project on-going. Completion by 31/01/03.	

Containment Sprays:

CARAIIDAS	IRSN (FRA)	Removal and retention of aerosols and gaseous iodine by spray droplets. Completed in 2001, facility in standby position.	' jacques.vendel@irsn.fr '
MISTRA	CEA (FRA)	Study of spray efficiency for steam condensation and effect on hydrogen (helium) concentration	' henri.paillere@cea.fr '
GIRAFFE-FP	NUPEC/Toshiba(JP N)	Aerosol removal by containment spray under AM conditions (completed and facility dismantled, data publicly available through publications and in reports).	' a-watanabe@nupec.or.jp '
GIRS	CIEMAT (SPA)	Gaseous iodine removal by sprays.	

Pool Scrubbing:

PECA	CIEMAT (SPA)	Pool scrubbing phenomena (jet regime and bubble regime). Aerosol retention within the secondary side of a steam generator during SGTR sequences.	luisen.herranz@ciemat.es
Heron	AEAT (UK)	Aerosol removal in churn turbulent conditions. Project complete. Data commercial and restricted to UK nuclear utilities. Facility decommissioned due to lack of funding.	christopher.benson@aeat.co.uk
Sandpiper	AEAT (UK)	Aerosol removal using gravel bed. Project complete. Data commercial and restricted to UK nuclear utilities. Facility decommissioned due to lack of funding.	christopher.benson@aeat.co.uk

Iodine Chemistry:

RTF	AECL (CAN)	Iodine behaviour and volatility under irradiation.	
CAIMAN	CEA/IRSN (FRA)	Iodine behaviour and volatility under irradiation (1500 Ci).	patricia.schindler@cea.fr
EPICUR	IRSN (FRA)	Iodine experiments under high radiation and high temperature.	tristan.montanelli@irsn.fr
IODE	IRSN (FRA)	pH buffering on I ² radiolysis, organic compounds, impurities, I ² mass transfers, radiolysis test (high temperature, w-w/o irradiation).	

PHEBUS-FP	IRSN(FRA)/JRC(EC)	Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	' michel.schwarz@irsn.fr ' ' bernard.clement@irsn.fr '
FENRIS	PSI (SWI)	In-situ iodine irradiation (behaviour of elemental and organic iodine species in gas and water under in-situ irradiation).	' salih.guentay@psi.ch '
Harwell Co-60 cell	AEAT (UK)	Iodine behaviour and volatility under irradiation. Facility to cease operation early in 2003 due to reorganisation and relocation.	' howard.sims@aeat.co.uk '

Integral Studies:

BTF	AECL(CAN)	Large scale in pile programme.	
PHEBUS-FP	IRSN (FRA)/JRC (EC)	Fission products, actinides and structural materials release from a degrading irradiated fuel. Transport in the RCS including retention and reemission. Behaviour in the containment vessel including aerosol physics and iodine chemistry. Five integral experiments 1/5000 scaling ratio four performed so far.	' michel.schwarz@irsn.fr ' ' bernard.clement@irsn.fr '

General :

ISARRP	EC Project 4 FWP	To collect the views of regulatory authorities about severe accident research.	
VASA	EC Project 4 FWP	To study validation strategies for severe accident code development.	

Severe Accident Management :

IVR-AM	NUPEC(JPN)/ NNC(Kazakhstan)	IVR feasibility with reactor pressure vessel cooling by spray and flooding (under way).	fukasawa@nupec.or.jp
EUBORA	EC Project	To define the needs for large scale boron dilution experiments.	
SAMEM	EC Project 4 FWP	To develop integrated SAM models for the assessment of the feasibility and effectiveness of potential SAM measures.	
SAMIIME	EC Project 4 FWP	To make an inventory of SAM Guidance in all EU countries; to develop a consensus opinion on SAMG; to define remaining SAM safety issues for research.	'vayssier@freeler.nl'
SAMOS	EC Project 5 FWP	To develop computerized support for implementing SAM using the OECD Halden CAMS model, and to obtain the time frame of major future events (e.g., H2 burns, RPV failure, releases).	'vayssier@freeler.nl'